Sana'a University Journal of Medical and Health Sciences

Impact of Education Program on Intensive Care Units Nurses toward Endotracheal Tube Care at Al-Thawra Hospital Sana'a– Yemen

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Abstract

Background: Endotracheal tube care is critical in ICU setting to prevent complications and improve patient outcomes. Building nurses' competence through structured education can enhance adherence to best practices.
Aim: To evaluate the impact of the educational training program on knowledge and practices regarding endotracheal tube care among ICUs at Al Thawra Hospital in Sana'a City-Yemen.
Methods: A pre-experimental, one-group pretest–posttest design was administered. This study was conducted in different ICUs. Data were collected using a questionnaire, face-to-face interviews, and an observational checklist. Data were analyzed using the IBM SPSS Software Program. Paired sample t-test and McNemar-Bowker test were used to examine the differences between pre- and post-educational intervention.
Results: ICNs were predominantly males (55.3%), mostly married (59.2%), with diploma qualifications (61.8%), and > 5 years of experience (84.2%). Post-intervention, total knowledge scores increased from 21.79 ± 4.34 to 25.28 ± 3.02 (t=5.33, p<0.001). total practice scores rose from 83,95± 36.12 to 124.55±43.42 (t=5.69, p<0.001). Changes were observed in the knowledge and practice levels, with highly significant improvements (p<0.001). The McNemar-Bowker test indicated a significant change in knowledge levels pre- and post-intervention (χ^2 =22.571; p <0.001) and in practice levels pre- and post-intervention (χ^2= 30.000; p <0.001).
Conclusion: The educational program produced significant and practically meaningful improvements in ICU nurses' knowledge and practice of ETT care. Ongoing training, periodic competency checks, and reinforcement of standardized protocols are recommended to sustain gains and optimize patient safety.

Article Info

Keywords:
Endotracheal tube, knowledge, practice, critical care nurse, educational program.

Article History:
Received: 1-March-2026,
Revised: 23-Abril-2026,
Accepted: 5-May-2026,
Available online: 28-June-2026

INTRODUCTION

Endotracheal intubation (ETI) is a common clinical procedure used to protect the airway and support the ventilation needs of critically ill patients [1]. This procedure involves the insertion of a large-bore, flexible, plastic tube made of polyvinyl chloride between the vocal cords through the trachea. It provides oxygen and inhaled gases to the lungs and protects them from contamination, such as gastric contents and blood [2].

Tracheal intubation (TI) is commonly performed in critically ill patients [3] (ETI) is a life-saving intervention widely used in critically ill patients to secure the airway and initiate mechanical ventilation. ETT care is an essential nursing practice for maintaining patient safety. Incompetent ETT care can increase patients' hospital stay, treatment costs, morbidity, and mortality. Intensive care units (ICUs) are assigned to deliver safe nursing care based on the best evidence.

Incompetent nursing care for intubated patients may be due to a lack of nurses' awareness and knowledge of current evidence-based practice. To optimize nursing care quality, nursing practice should be based on scientific knowledge and standardized evidence-based practice [1]. Hence, this review aims to highlight recent evidence related to ETT nursing care. Therefore, this study aimed to develop local protocols or guidelines to promote nurses' knowledge and practices of caring for

patients with endotracheal tubes in intensive care units [4].

AIM OF THE STUDY

To evaluate the impact of an educational training program on knowledge and practices regarding endotracheal tube care among critical care nurses at Al Thawra Hospital in Sana'a City, Yemen.

SUBJECTS AND METHODS

This study adopted a pre-experimental, one-group pretest–posttest design to evaluate the impact of an educational training program on ICNUs' knowledge and practices of the NICU staff regarding ETT care at Al-Thawra Hospital in Sana'a City, Yemen. This design was utilized from 01st, 2025 to 01st, 2025. Per-test data collection was conducted in the first month. In the second month, the educational program was implemented for nine subgroups of nurses in the designated ICUs. Each subgroup received four training sessions, consisting of two theoretical and two practical sessions. Each session lasted for approximately 45 min. Post-test data were collected from different ICUs at Al-Thawra Hospital in Sana'a City, Yemen, in the third and fourth months.

The study was conducted in different ICUs (Emergency Intensive Care Unit, Medical Intensive Care Unit, Surgical Intensive Care Unit, Cardio Care Unit, Neuro Intensive Care Unit, Pediatric Intensive Care Unit, Nephron Intensive Care Unit) at Al-Thawra Hospital in Sana'a City, Yemen. Al-Thawra Hospital is a public hospital in Yemen that provides primary, secondary, and tertiary healthcare for patients.

The study population included all nurses working in the ICUs at Al-Thawra Hospital in Sana'a City, Yemen.

The sample size was calculated using G*Power software for paired-sample t-test (effect size = 0.4, α = 0.05, power = 0.80) and two-tailed test. Based on these parameters, the initial sample size required was 69. To account for potential dropouts, which were estimated at 10%, the final adjusted sample size was 76 intensive care nurses (ICNs).

A purposive sampling method was employed to select participants from all ICNs working in the ICUs at Al-Thawra Hospital. In this type of sampling, the sample was selected based on the researchers' judgement regarding participants who were especially knowledgeable. This is ideal primarily when there is a limited number of people expertise in the area being researched

The exclusion criteria:

- ICNs who did not agree to participate in the study.
- All ICNs who did not meet the inclusion criteria.

Data collection

Tool I: A structured questionnaire

A structured questionnaire was administered pre- and post-intervention to evaluate the knowledge of the ICNs regarding ETT care. The variables used in the development of the questionnaire were mostly by reviewing the related literature and the previous studies [5–7]. These variables have been investigated by other researchers in other settings. Legibility and completeness of the data were ensured during the data collection period, and any inconsistencies were addressed during the fieldwork.

An observational checklist was used pre- and post-intervention to evaluate the ICNs' practices of ETT care. The variables used in the development of the observation checklist were mostly obtained by reviewing the related literature and previous studies [6–8].

Educational program intervention

The study was conducted in four phases

(1): Preparatory phase: Official permission to conduct the study was obtained from the hospital authorities responsible for the ICUs after explaining the aim and nature of the study. The aim of the study, in addition to the written explanations on the covering letter of the questionnaire, were explained to the ICNs.
(2): Assessment phase: Assessing the ICNs' knowledge of ETT care to determine their educational needs using (tool I). Assessing the ICNs' practice of ETT care (Tool II).
(3): Implementation phase: The ICNs were asked to fill in a questionnaire (tool I) to assess their knowledge of ETT care before the ETT care. The researcher filled out the observation checklist to assess the ICNs.' practices prior to the application of ETT care (tool II). Teaching was implemented for the ICNs in terms of sessions and teaching on the spot during their official working hours.
(4): Evaluation phase: The knowledge and practice of each nurse were evaluated twice, immediately and directly, before and after the educational intervention. The same pre-test study tools (questionnaire and observation checklist) were used in the post-intervention for the studied subjects to test the effectiveness of the program on ICNs' knowledge and performance. A comparison was performed between the pre- and post-educational intervention programs. Regarding the scoring system for performance, a score of one was given to the performed task and a score to the unperformed or incorrect task. Data were analyzed using the IBM SPSS Version 27. Descriptive statistics were used to summarize the participant characteristics. Paired sample t-test and McNemar-Bowker test were used to examine the differences in the knowledge and practices of ICNs toward ETT pre and post the educational intervention. Associations between

Table 1. Demographic characteristics of ICNs (n=76).

Age (years)	**F**	**%**
• 20-40	35	46.1
• 40-60	28	36.8
• >60	13	17.1
Gender		
• Male	43	55.3
• Female	33	43.4
Marital status		
• Single	26	34.2
• Married	45	59.2
• Divorced	3	3.9
• Widowed	2	2.6
Educational qualification		
• Diploma degree	47	61.8
• Bachelor degree	24	31.6
• Master degree	5	6.6
Years of experience		
• < 5	12	15.8
• > 5	64	84.2

knowledge, practices, and sociodemographic variables were examined using chi-square tests. When >20% of cells had expected counts <5 or any cell had expected counts <1, likelihood ratio or continuity-corrected chi-square tests were used. The reliability of the scales was evaluated using Cronbach's alpha, with values $\geq$.70 considered acceptable. Statistical significance was set at p-value < .05. Ethical approval was obtained from Sana'a University and the targeted hospitals. Verbal informed consent was obtained from all participants before data collection.

RESULTS

Table (1) shows that regarding age, 46.1% were between 20 and 40 years old (mean = 1.80 ± 0.712 SD). More than half of the ICNs (55.3%) were male. The majority of ICNs were married (59.2%). Most ICNs held a diploma degree (61.8%) as their highest educational qualification. Over half (57.9%) had 6-10 years of nursing working experience (mean ±SD = 2.14 ± 0.725).

Table (2) The mean ± SD score pre-intervention was (21.79± 4.34) compared to post-intervention (25.28 ± 3.02), which was significantly higher than the pre-intervention scores. The mean and SD differences in the ICNs' total general practices of ETT pre- and post-educational program. The mean ± SD score pre-intervention was (83.95± 36.12) compared to post-intervention (124.55± 43.42) which was significantly higher than the pre-intervention scores.

Table (3) Demonstrates the statistical significance of these shifts. The McNemar-Bowker test indicated a significant change in knowledge levels pre- and post-intervention (χ^2 =22.571; p <0.001). Additionally, the Marginal Homogeneity test confirmed that the observed changes in knowledge levels were statistically significant (χ^2 = 47.000; p <0.001).

Table (4) Presents the statistical significance of these shifts. The McNemar-Bowker test was conducted and indicated a significant change in practice levels pre- and post-intervention (χ^2 = 30.000; p <0.001). Additionally, the Marginal Homogeneity test confirmed that the observed changes in practice levels were statistically significant (χ^2 = 99.000; p <0.001).

1. DISCUSSION

The present study revealed that nearly 46.1% of the critical care nurses age group (46.1%) were between 20 and 40 years old (mean = 1.80 ± 0.712 SD), predominantly male (55.3%), married (59.2%), and held a diploma degree (61.8%). Over half (57.9%) had 6-10 years of nursing working experience (mean ±SD = 2.14 ±

Table 2. Presents the mean and SD differences in ICNs' total general knowledge and practice of ETT

Variables	Mean	SD	Paired differences	*p*-value
Knowledge				
• Pre intervention	21.79	4.34	3.48 ± 5.71	0.000
• Post intervention	25.28	3.02		
Practice				
• Pre intervention	83.95	36.12	40.61 ± 46.77	0.000
• Post intervention	124.55	43.42		

Table 3. Level of knowledge toward ETT care pre-post intervention among ICNs

Level of knowledge pre-intervention * Level of knowledge post-intervention					
Knowledge level toward ETT care		Post-intervention			**Total**
		Low	Moderate	High	
Pre-intervention	Low	12 (16%)	23 (30%)	8 (10%)	43 (57%)
	Moderate	5 (6.6%)	24 (31.6%)	3 (4.9%)	32 (42%)
	High	0 (00%)	0 (00%)	1 (1.3%)	1 (1.3%)
	Total	17 (22.3%)	47 (61.8%)	12 (15.8%)	76 (100%)

0.725). These findings are consistent with prior literature demonstrating in India [4] who reported that the majority of their study samples were young nurses (55.4 %). The mean age of the nurses was 31.74 ± 5.69 SD, most of them (92%) were female, and 60.5% were married. Approximately more than two-thirds of the nurses had a diploma in nursing, 14% had a bachelor's degree as their highest level of qualification, and the majority had almost 10 years of ICU experience (90.8%). Five nurses had over 20 years of experience in the ICU. Most of them were married and had children. The current intervention produced substantial improvements in both knowledge and practice, with total knowledge scores rising from **21.79 ± 4.34 to 25.28 ± 3.02** (mean difference = 3.49; t (75) =5.33; p<0.001; Cohen's d=0.611)

and practice scores increased from **83.95 ± 36.12 to 124.55 ± 43.42** (mean difference = 40.61; t (75) =7.569; p<0.001; Cohen's d=0.868).

These findings closely mirror the previous evidence. Compared with this, the present study still showed a residual percentage of nurses with low knowledge (22.4%) after the program, suggesting that while the intervention was effective, its impact

was somewhat less absolute than in the neonatal intensive care unit study, similarly, in the Sudanese [9].

Regarding the ETT and tracheostomy care study, the percentage of nurses with adequate suctioning practice increased from 54.0% in the pre-intervention phase to 70.4% and 78.7% in subsequent post-tests, with clear enhancement in key steps, such as connecting the suction tube and recording the procedure and patient tolerance. In the impact program study on endotracheal suctioning, approximately two-thirds of the nurses improved their practice scores post-intervention, and a significant association was found between total knowledge and practice scores. Among the 43 ICNs who initially had low knowledge, 23 (53.5%) improved to a moderate level and 8 (18.6%) improved to a high level post the intervention, while 12 (27.9%) remained in the low category. This means that **more than 70% of initially low-knowledge nurses moved upward** after the educational program. This positive shift is comparable to the transformation reported in the NICU study, where 100% of staff nurses ultimately achieved good knowledge after training.

Conversely, the findings of the present study differ from those in India [10], which showed that some nurses remained at a low level post-intervention, whereas the neonatal intensive care unit study achieved universal improvement. This may be related to the broader and more heterogeneous responsibilities of ICNs (ventilator management, hemodynamic monitoring, multi-organ support) compared with NICU staff focusing on ETT suctioning; heavier workload and time constraints in adult ICUs and cardio care units, limiting opportunities for practice and reflection; possible differences in pedagogical strategies; for instance, programs that use repeated demonstra-

Table 4. Levels of practice toward ETT care pre and post intervention among ICNs

Level of practices pre-intervention * Level of practices post-intervention					
Levels of practice toward ETT care		Post-intervention			**Total**
		Low	Moderate	High	
Pre-intervention	Low	14 (18.4)	0 (00%)	19 (25%)	33 (43.4%)
	Moderate	0 (00%)	17 (22.3%)	14 (18.4)	31
	High	0 (00%)	0 (00%)	12 (15.8%)	12 (15.8%)
	Total	14 (18.4)	17 (22.3%)	45 (59.2%)	76 (100%)

tion and re-demonstration, hands-on supervised practice, and continuous feedback have been shown to maintain higher levels of performance [11].

This study explored the association between critical care nurses' demographic characteristics and their knowledge and practice of ETT care before and after the educational intervention. The findings revealed that demographic variables had limited influence on knowledge and practice outcomes, with the exception of marital

status, and prior training in ETT care, which demonstrated statistically significant associations post-intervention. The findings of the current study showed that there was no association between demographic characteristics (age, gender, marital status, education, years of experience, and courses training in EET care) and the ICNs' practice levels of ETT care in both pre- and post-intervention ($p > 0.05$). The lack of association between knowledge or practice scores and variables such as age, gender, education level, and years of experience aligns with multiple international studies. Similarly, no significant association was found between demographic factors and nurses' knowledge of ETT care. These findings suggest that clinical competency in airway management is not inherently determined by demographic background but rather by exposure to structured training, clinical reinforcement, and ongoing training. This pattern partially contrasts with that of an impact program study, where education level and years of ICU experience were significantly associated with baseline knowledge and practice scores [12]. Similarly, some evidence from other studies indicates that older and more experienced nurses may have better baseline knowledge of ETT-related care [13].

CONCLUSION

Based on the findings of the present study, it was concluded that there was a highly statistically significant difference between the nurses' knowledge and practice before and after the program's implementation. Improving nurses' knowledge and practice has a favorable effect on preventing or reducing post-endotracheal tube care complications.

RECOMMENDATIONS

According to the findings of the present study, the following recommendations are introduced: For nurses: Continued nursing education and in-service training programs in intensive care units should be organized at Al Thawra Hospital and equipped with the necessary educational facilitators and materials to upgrade the knowledge and practices of practicing nurses, which will be reflected in better outcomes for patients. Nurses could be more motivated to have better practice in their work. Nurses should be aware by post endotracheal tube care complications, how to prevent it and how to deal with it when to develop.

For administration: Adequate supplies and facilities should be available in the unit. Newly employed nurses in traumatic and general intensive care units are required to successfully complete a test of basic knowledge and practice before assuming independent patient care responsibilities.

For further research, the study could be replicated on a larger probability sample acquired from different geographical areas in Yemen to determine the main aspects of these problems.

Ethical clearance
This study was approved by the Faculty of Medicine and Health Sciences at Sana'a University Ethics Committee.
Informed Consent: N/A
Competing interests: None declared
Funding: Nil
Authors' contributions: Concept NM; Design – NM, NA.; Data Collection - NM. Data processing, analysis, and interpretation: NA. Literature search: NM and NA performed the literature search.; Writing – NM and NA.

Critical Reviews – NM and NA.

All authors have read and agreed to the published version of the manuscript.

Acknowledgements

The authors gratefully acknowledge all the nurses for their cooperation and positive responses.

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